

CLAIMS

1. A lighting apparatus of high intensity discharge lamp comprising:
 - a DC power source;
 - a series connection of a first switch and a second switch;
 - a series connection of a first capacitor and a second capacitor which is connected in parallel with the series connection of the first switch and the second switch, a voltage between both terminals of the first capacitor being selected to be different from that of the second capacitor;
 - a series connection including at least an inductor;
 - a high intensity discharge lamp connected between a connection point of the first switch and the second switch and another connection point of the first capacitor and the second capacitor;
 - a third capacitor connected in parallel with the high intensity discharge lamp; and
 - a control circuit for switching on and off of the first switch and the second switch so as to supply electric power to the discharge lamp.
2. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein
 - the voltages between the both terminals of the first capacitor and the second capacitor are set to be different from each other while at least the discharge lamp has not been lighted.

3. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

the voltages between the both terminals of the first capacitor and the second capacitor are set to be different from each other owing to selecting capacitances of the first capacitor and the second capacitor different from each other, and

values of the capacitances of the first capacitor and the second capacitor are selected in a manner so that a ratio of division of the larger value of the capacitance with respect to the other is in a region from 1.6 to 15.

4. The lighting apparatus of high intensity discharge lamp in accordance with claim 3, wherein

a lower value of the voltages between both terminals of the first capacitor and the second capacitor is equal to or larger than a rated voltage of the high intensity discharge lamp.

5. The lighting apparatus of high intensity discharge lamp in accordance with claim 3, wherein

A higher value of the voltages between both terminals of the first capacitor and the second capacitor is in a range from equal to or larger than 250V to equal to or smaller than 450V.

6. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

output voltage from the DC power supply is in a range from equal to or larger than 300V to equal to or smaller than 480V.

7. The lighting apparatus of high intensity discharge lamp in

accordance with claim 1, wherein

a switching frequency of one of the first switch and the second switch which is connected to one of the first capacitor and the second capacitor having the higher voltage between both terminals thereof is higher than that of the other while the high intensity discharge lamp has been lighted.

8. The lighting apparatus of high intensity discharge lamp in accordance with claim 7, wherein

the switching frequency higher than the other is integral multiple of the switching frequency of the other.

9. The lighting apparatus of high intensity discharge lamp in accordance with claim 2, wherein

a magnitude relation between the voltages between both terminals of the first capacitor and the second capacitor are alternately changed while the high intensity discharge lamp has not been lighted.

10. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

the first switch and the second switch are switched on and off in a manner so that a frequency of rectangular alternating voltage component allied to the high intensity discharge lamp in a predetermined term after starting up of lighting of the high intensity discharge lamp is made lower than the frequency of the rectangular alternating voltage component after passing the predetermined term.

11. The lighting apparatus of high intensity discharge lamp

in accordance with claim 10, wherein

the frequency of the rectangular alternating voltage component is selected to be a value by which no acoustic resonance occurs in the high intensity discharge lamp.

12. The lighting apparatus of high intensity discharge lamp in accordance with claim 10, wherein

the frequency of the rectangular alternating voltage component in the predetermined term is in a range from 0 to several tens Hz.

13. The lighting apparatus of high intensity discharge lamp in accordance with claim 10, wherein

the frequency of the rectangular alternating voltage component in the predetermined term is an inverse number of a time necessary for roundly varying the voltage of at least one of the terminals of the first capacitor and the second capacitor between higher voltage and lower voltage of the first capacitor and the second capacitor while the discharge lamp has not been lighted.

14. The lighting apparatus of high intensity discharge lamp in accordance with claim 10, wherein

the frequency of the rectangular alternating voltage component in the predetermined term is an inverse number of a time necessary for roundly varying the voltage of at least one of the terminals of the first capacitor and the second capacitor between a largest voltage applicable to the first capacitor and the second capacitor and a voltage which is a subtraction of the largest value from the output voltage from the DC power supply.

15. The lighting apparatus of high intensity discharge lamp in accordance with claim 10, wherein

the frequency of the rectangular alternating voltage component in the predetermined term is an inverse number of a time necessary for roundly varying the voltage of at least one of the terminals of the first capacitor and the second capacitor between a predetermined voltage and a voltage which is a subtraction of the predetermined value from the output voltage from the DC power supply.

16. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

a low frequency rectangular alternating electric power supplied to the high intensity discharge lamp is controlled by switching on and off the first switch and the second switch utilizing sensing results of the voltage between the terminals of the high intensity discharge lamp and the voltage between the terminals of at least one of the first capacitor and the second capacitor.

17. The lighting apparatus of high intensity discharge lamp in accordance with claim 16, wherein

the sensing result of the voltage between the terminals of the high intensity discharge lamp is utilized in a half period of the low frequency rectangular alternating electric power supplied to the high intensity discharge lamp, and the sensing result of the voltage between the terminals of at least one of the first capacitor and the second capacitor is utilized in the rest half period.

18. The lighting apparatus of high intensity discharge lamp

in accordance with claim 1, wherein

the output voltage from the DC power source is varied corresponding to the voltage between the terminals of the high intensity discharge lamp.

19. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

the DC power source comprise a rectifier for rectifying AC current of an AC power source to DC current; and

the output voltage from the DC power supply is varied corresponding to an input voltage from the AC power source.

20. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

a current flowing in the inductor is controlled in BCM (Boundary Current Mode);

the inductor and the third capacitor configures a filter; and

a compensator for compensating a gain with respect to one of negative and positive phases of AC current flowing in the inductor substantially equal to a gain with respect to the other phase is further comprised.

21. The lighting apparatus of high intensity discharge lamp in accordance with claim 20, wherein

the compensator is configured by a fourth capacitor connected between a first connection point of the first switch and the second switch and a second connection point of the first capacitor and the second capacitor, and a second inductor connected between the fourth

capacitor and one of the first connection point and the second connection point.

22. The lighting apparatus of high intensity discharge lamp in accordance with claim 20, wherein

the compensator varies an inductance value of the inductor corresponding to negative and positive phases of the AC current flowing in the inductor.

23. The lighting apparatus of high intensity discharge lamp in accordance with claim 20, wherein

24. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

a series connection of a third switch and a diode is connected in parallel with the series connection of the first capacitor and the second capacitor in a manner so that a current from the first capacitor or the second capacitor to the third switch is interdicted by the diode; and

a third inductor is connected between a first connection point of the first capacitor and the second capacitor and a second connection point of the third switch and the diode.

25. The lighting apparatus of high intensity discharge lamp in accordance with claim 1, wherein

a series connection of a third switch and a fourth switch is connected in parallel with the series connection of the first capacitor and the second capacitor; and

a third inductor is connected between a first connection point

of the first capacitor and the second capacitor and a second connection point of the third switch and the fourth switch.